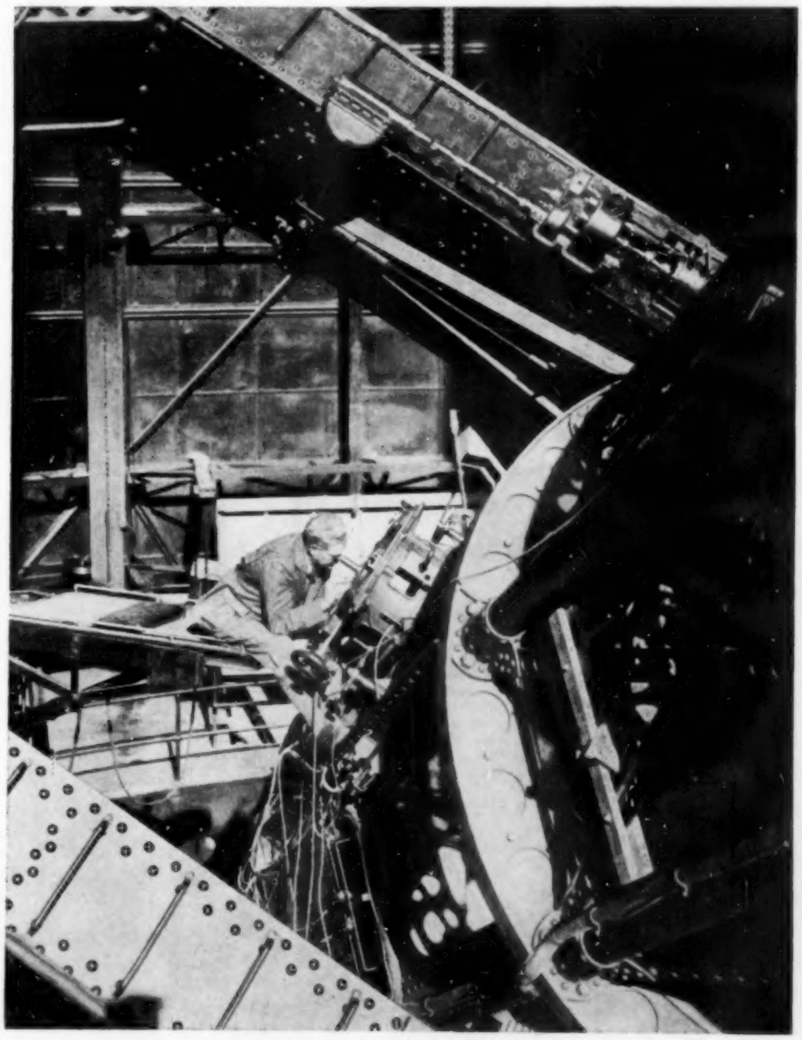
SCIENCE NEWS-LETTER

The Weekly Summary of Current Science

A SCIENCE SERVICE PUBLICATION

$5 a year 15c a copy **May 5, 1928**



PLUMBING THE DEPTHS OF SPACE

The 100" Reflecting Telescope at Mt. Wilson

(*See page* 274)

Vol. XIII **No. 369**

Earthquakes Report Themselves

Seismology

The destruction of Philippopolis in Bulgaria by the disastrous earthquake of April 18 was reported to scientists by the earthquake itself three days before the wrecked telegraphic service could be restored to bring the news to the outside world. Numerous seismograph observatories reported their data to Science Service as fast as the records could be deciphered. These were telephoned to the seismologists of the U. S. Coast and Geodetic Survey, who combined them and plotted off the distances on the map. The lines intersected across the doomed city of Philippoplis. A Science Service news item reported the location of the epicenter at Philippopolis on April 19; on April 21 the first direct wires were received telling of the destruction of the city.

A similar long lead over the wires occurred only a few days before that, when on April 10 instrumental data located the epicenter of the earthquake that devastated eastern Peru, details of which did not appear in the wire news until April 17.

The seismograph stations cooperating in the reporting of data on these two quakes were those of the U. S. Bureau of Standards, Washington; the U. S. Coast and Geodetic Survey, Chicago and Tuscon, Ariz.; the Dominion Observatory, Ottawa; the Meteorological Observatory, Victoria, B. C., and the stations of the Jesuit Seismological Association at Georgetown University, Washington; Fordham University, New York City; Loyola University, New Orleans, and St. Louis University, St. Louis.

The longest lead ever obtained by an earthquake in making its own announcement occurred on May 23, 1927, when Science Service cooperated with government and non-official seismologists in reporting the great quake in Kansu Province, China, which killed over 100,000 persons. The first news to reach the world through ordinary channels came out during the latter part of July, when a missionary priest who had been in the region when the disaster occurred worked his way to the nearest telegraph station, hundreds of miles from the damaged area.

Science News-Letter, May 5, 1928

The Depths of Space

Astronomy

It was only a few years ago that astronomers were unable to measure the distance of objects in the sky more than a hundred thousand or so light years away. But now at the Mt. Wilson Observatory they have photographed spiral nebulae at distances so great that our own system of stars—the galaxy—is of minute size in comparison. So remote are some of these that their light has been on the way to us since remote geological ages.

This has been done with the 100-inch telescope, the world's largest, which is depicted on our cover this week. Seated on the observing platform is Francis G. Pease, in charge of the Mt. Wilson Observatory's shops, and under whose supervision the great instrument was built. The concave mirror, 100 inches in diameter, that brings the light rays to a focus, was the work of Prof. George W. Ritchey, who has been working for several years at the Paris observatory to find the best way of making still larger telescopes.

At the time of the great Roman chariot races, swallows were brought from distant towns and at the end of the races were marked with the winning colors and set free to fly home.

In This Issue—

SCIENCE NEWS-LETTER, The Weekly Summary of Current Science. Published by Science Service, Inc., the Institution for the Popularization of Science organized under the auspices of the National Academy of Sciences, the National Research Council and the American Association for the Advancement of Science.

Edited by Watson Davis.

Publication Office, 1918 Harford Ave., Baltimore, Md. Editorial and Executive Office, 21st and B Sts., N. W., Washington, D. C. Address all communications to Washington, D. C. Cable address: Scienservc, Washington.

Entered as second class matter October 1, 1926, at the postoffice at Baltimore, Md., under the act of March 3, 1879. Established in mimeographed form March 13, 1922. Title registered as trade-mark, U. S. Patent Office.

Subscription rate—$5.00 a year postpaid. 15 cents a copy. Ten or more copies to same address, 5 cents a copy. Special reduced subscription rates are availabe to members of the American Association for the Advancement of Science.

Advertising rates furnished on application.

INTERPRETING week by week, the latest developments in the various fields of science, this magazine attempts also to present its articles in the most pleasing and readable topography and the most convenient arrangement.

The *clippability, indexing,* and *automatic dating* of each article are unique features.

This is a *separable* magazine. Each original article can be clipped or torn out without losing or damaging another important article on the other side. These original articles are backed by reprinted quotations or excerpts, short one-sentence items, advertisements, and other material not likely to be clipped and preserved.

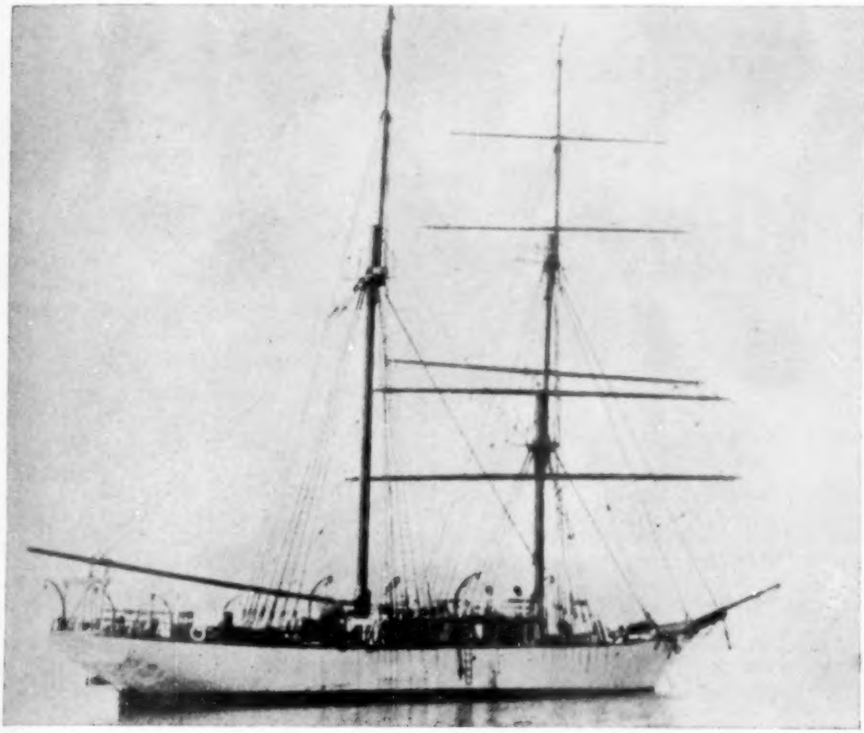
Each article is automatically *indexed* by the key word printed in italics just below the heading, or at the end of the article when the article has no heading. Articles can thus be filed easily into any system of classification, whether it be Library of Congress, Dewey, or one of the reader's own devising.

Each article is automatically *dated* by its last line.

All of the resources of Science Service, with its staff of scientific writers and correspondents in centers of research throughout the world, are utilized in the editing of this magazine.

Laboratory Yacht Sails on Science Quest

Oceanography



THE "CARNEGIE"—non-magnetic yacht of the Carnegie Institution's Department of Terrestrial Magnetism, now crossing the Atlantic Ocean on the first lap of a three-year cruise to all the seven seas

By James P. Ault

Last Tuesday morning, May 1, the Carnegie Institution's non-magnetic ship "Carnegie" sailed down the Potomac River from Washington for a three-year cruise through all of the seven seas. In the following article, prepared especially for Science Service just before its departure, Captain James P. Ault, the ship's commander, tells what they expect to accomplish before they return.

How would you like to spend the next three years making a trip around the world on a sailing ship? This is to be the experience of eight men selected by the Carnegie Institution of Washington, and they are to sail about May 1 on the non-magnetic yacht Carnegie. This vessel has already made six voyages, covering about 290,000 miles, in making a magnetic and electrical survey of the oceans. She was especially constructed and equipped for making these investigations, brass and copper being used instead of iron and steel in her construction, since the latter metals cause uncertain errors in the delicate instruments used in making the observations.

After an interval of over six years, the Carnegie is once more to wander down the latitudes in quest of general scientific information. We shall sail first for England and Germany, and then to Iceland. As the sun goes southward next fall, so we shall sail south for the West Indies and Panama, spending next winter in the south Pacific, visiting the Society Islands, Easter Island and Peru and coming north again to Japan and California next summer. And so on around the world, following the sun in order to avoid storms and delays due to wintry weather and to improve the conditions for making our investigations. Among the places to be visited after leaving California are Honolulu, Samoa, New Zealand, Cape Horn, South Georgia, South Africa, Ceylon, India, Western Australia; across the South Pacific again and around the Horn to Buenos Aires, Argentina, St. Helena, Azores, Madeira, and back to Washington in September, 1931.

But you must not be too envious of us, because this is not to be a pleasure jaunt, but is an expedition to be devoted entirely to scientific research work at sea.

The first reason for our going is to find out what changes have taken place in the magnetic conditions over the various ocean areas since the previous cruises of the Carnegie. This information is of interest to the student of the earth's magnetism in his study of the many unsolved problems in this science, and it will supply the values needed to keep the navigation charts up to date. These charts are used by the air pilot as well as by the sea pilot.

Among the unsolved problems are, what is the origin of the earth's magnetic field, what are the causes of the daily and seasonal changes in this field, the close relation between magnetic storms and the occurrence of polar lights and changes in the condition of the sun, and why we have eleven-year periods in magnetic changes and disturbances coincident with the well-known eleven-year periods in sunspot activity.

The second important investigation to be made will be to continue the study of the earth's electric field. The importance of these investigations has increased in recent years because of the close relation between variations in atmospheric electricity and variations in magnetic conditions, also recent theories regarding the nature of electricity and the constitution of matter and the rapid advances made in radio transmission have given added stimulus to these studies.

Recent investigations of variations in radio transmission with changing magnetic and electric conditions have led us to install a very complete radio equipment on the Carnegie for the first time. Short wave broadcasts will be received during the entire cruise and a definite program of transmission and reception is being arranged with the Naval Research Laboratory here in Washington. Thus we shall carry out experiments and investigations on the important problem of skip-distances and of variations in signal-intensity. Time signals will be received daily, thus adding to the accuracy of our time-keeping and consequently to the reliability of our geographical positions at sea.

The third general scientific problem to be investigated is known as oceanography.

In spite of the considerable amount of information which has been accumulated by the various expeditions since the time of the Challenger voyage in 1872 to 1876, we have only a general idea of the contours of the ocean bed, and only a meager knowledge of the bottom sedimentary deposits which are of peculiar interest in the study of the age and formation of the earth and (*Turn to next page*)

"Carnegie"—*Continued*

the changes which time has witnessed. The mapping of the configuration of these great basins covering over two-thirds of the earth's surface should be as important as the mapping of the land masses which occupy less than one-third.

So we have installed one of the recently perfected sonic depth-finders, loaned by the U. S. Navy Department, and we can determine in a few moments the depth of the ocean as the vessel is proceeding on her course. The method consists of measuring very accurately the time it requires for sound sent out from the ship to travel to the bottom of the ocean and the echo to return to the ship again. Sound travels in water at the rate of about 4,800 feet, a little less than one mile, per second, so that if the time between signal and the echo is two seconds, the depth is about 4800 feet.

Perhaps the most fascinating study connected with the sea is the multitudinous life found in all oceanic waters from the surface down to the deepest abyss yet explored. Physical and chemical changes in the ocean-waters have profound influence upon marine life, its variety, its amount and its distribution. A knowledge of these influences will contribute in many ways not only to the study of evolutionary processes taking place in the sea but also to the practical problem of economic use of the ocean's food supply.

Science News-Letter, May 5, 1928

Animal Breeding

Agriculture

SYDNEY HILLYARD, in the *Scientific Monthly:*

In the breeding of animals the work of one man is not enough to furnish more than a mere foundation upon which his sons, grandsons and great-grandsons must build. The work of selection—the picking out of the strongest or fastest horse, the heaviest wooled sheep, the cow with the most or the richest milk—must continue for generations unbroken, or we can quickly have a retrogression, a devolution back to the wild stock—a much easier thing to get than an evolution toward the perfect specimen that has become so necessary to modern life.

Science News-Letter, May 5, 1928

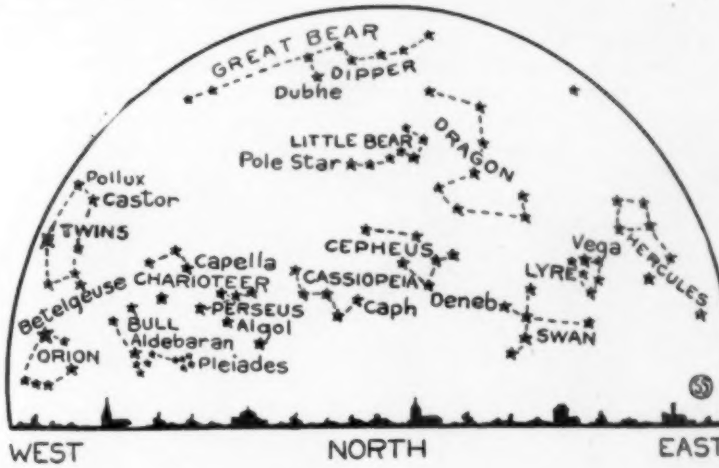
A few centuries ago men of science believed that diamonds had sex and reproduced as living creatures do.

Eclipse, Saturn and Mercury In May

Astronomy

By James Stokley

The first eclipse of the sun this year, the return of the ringed planet Saturn to the evening sky, and the appearance of the seldom-seen Mercury as an evening star; all these things go to make the month of May interesting to the student of the stars. It is particularly interesting because the last few months have brought forth little in the way of astronomical interest.



A total eclipse of the sun, when the moon in its travels passes in front of the solar disc revealing the otherwise invisible corona, usually attracts the attention of astronomers from all parts of the world. Many a time has a party of astronomers traveled thousands of miles to take a chance that the weather would be clear for two or three minutes on a certain day months in advance. Not quite so often have they been disappointed by the eclipse itself being eclipsed by clouds at the crucial moment.

At the eclipse on the 19th of May, however, it is unlikely that there will be much disappointment even if the weather is cloudy at the place where it will be visible, because no astronomers will travel to see it. Even if they wanted to get there they would probably need to use airplanes to do so. The path of totality, in which the sun is completely obscured by the dark disc on the moon, is at approximately latitude 50 degrees south and 20 degrees east. This is over a thousand miles south of the southern tip of South Africa. It is a region where there are no islands or other places on which to set up instruments and so for at least once, astronomers will rest content at having an eclipse happen in some other part of the world.

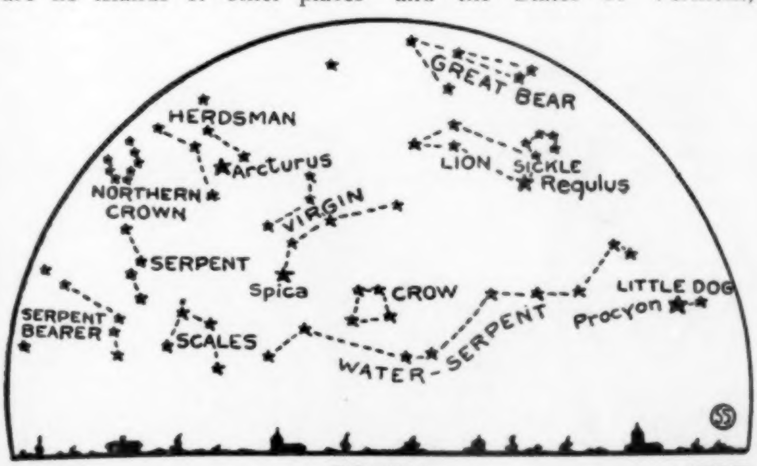
The region over which the sun will be partly obscured, in other words, where there will be a partial eclipse, is much larger. In practically all of South Africa and in the southern part of South America, the partial eclipse will be seen.

It will be necessary to wait just about a year for the next really good eclipse for observing purposes. That will take place on May 9, 1929. The path of totality then will cross the Indian Ocean, the Malay Peninsula and several of the islands in the Philippine group. The next really convenient eclipse does not take place until 1932. In that year there will be one of which the path of totality will cross parts of the Province of Quebec and the States of Vermont, New Hampshire, Maine and Massachusetts. As this happens at 3:30 o'clock on the afternoon of August 31, it will undoubtedly be a popular attraction. If the weather is clear, it should break all records for the number of people observing an eclipse.

But, while the circumstances of this eclipse are already known, and if they desired astronomers could set up their instruments now for use in 1932, they are not bothering to do so. They are, however, beginning to think of the next satisfactory eclipse for observing which is the one in the Philippines on May 9, 1929.

At the end of the month of May it will be possible for amateur star gazers to see one of the most important members of the solar system, yet one which few people have ever seen. It is the planet Mercury, nearest of all the known planets to the sun. The average distance of the earth from the sun is about 93 million miles. Mercury remains on the average of only 36 million miles from the ruler of the solar system. It revolves around it once in 88 days instead of 365¼ days as the earth.

Because of its rapid revolution around the sun, combined with its short distance, Mercury seems to oscillate from one side of the sun to the other as the latter body travels among the stars in its annual path. Mercury cannot be seen when the sun is above the horizon because of the glare. A large part of the time, when the two are close together, they both set at about the same moment in the evening, and rise about the same time the next morning. Thus, at such times, (*Turn to next page*)



HOLD THIS PAGE IN FRONT OF YOU and face north or south. The upper or lower map will then reveal the May evening sky as it appears on a clear night

The Heavens in May—*Continued*

Mercury cannot be seen at all. Once in each of its revolutions in its orbit, Mercury gets to its maximum distance eastward of the sun and then about six weeks later in the same distance westward. The former is called greatest eastern elongation and the latter greatest western elongation. The eastern elongation is its best position, so far as we are concerned. Then the sun sets first and Mercury an hour or so later, so that it can be seen in the twilight.

It will be an eastern elongation that will bring Mercury into the evening sky at the end of this month. Actually the elongation itself occurs, not in May, but on the third of June. However, for perhaps a week at the end of May the planet should be seen. It will be very low in the western sky and, therefore, rather difficult to observe, but a pair of binoculars, or even a good pair of opera glasess, should aid in finding it. Then when it is seen the observer will have the satisfaction of having seen an important member of our family of planets and one which even the great Copernicus is said never to have observed.

The alternate appearance of Mercury in the evening and morning skies was first observed by the ancient Greeks. However, they did not realize that it was a single planet that performed these gymnastics. They thought that there were two planets, and called the one in the evening Mercury and the one in the morning Apollo. Somewhat similar was the case with Mercury's next-door neighbor in the solar system, the planet Venus. This also appears first in the evening and then in the morning skies, though at greater intervals than does Mercury. The Greeks had two names for it, Phosphorus when it appeared in the morning and Hesperus when it was seen in the evening sky.

The other planet that is coming into the May evening sky is not so difficult to observe as Mercury, and will not be visible until later in the evening. This is the planet Saturn. It rises in the east about two hours after the sun sets in the west; about 1:30 in the morning it is directly south. It appears as a bright star, with a rather steady yellowish light as distinguished from the twinkling of the stars.

Saturn, of course, is of chief interest because of its remarkable system of rings. In order to see the rings of Saturn satisfactorily a small sized telescope is required, one magnifying perhaps 30 or 40 times.

The rings were first seen by the Italian astronomer, Galileo, who had an instrument inferior even to a modern pair of opera glasses. However, he was not able to see the rings as such and he never realized just what they were. To him it looked as if Saturn was attended by two smaller bodies, one on either side. These seemed to wax and wane depending upon whether or not the earth was directly in line with the rings. Some years later the Dutch astronomer, Huyghens, observed the rings with a large telescope and discovered for the first time what they were.

The stars in the evening sky reflect the coming of the middle of spring. Late in the evening the bright Vega, in the constellation of Lyra, the Harp, can be seen in the eastern sky. Below it to the right appears Altair, in Aquila, the eagle, and, to the left, Deneb, and the other bright stars that form the group of the northern cross, or Cygnus, the swan. By next month these three stars will be conspicuous throughout the evening.

High overhead now, shortly after sunset, is the familiar sickle, in Leo, the lion, with the first magnitude Regulus, at the end of the handle, to the south. East of this group is the faint group of stars known as Coma Berenices, or Berenice's hair. According to legend this was originally part of the tail of the lion, but the constellations were changed in honor of an ancient queen.

Orion is now leaving us for the season, as this group is very low in the west, just after sunset. Somewhat higher are the two twins, Castor and Pollux. In the northeast is Capella, in Auriga, the chairoter.

Science News-Letter, May 5, 1928

Bones of at least 2,000 hippopotami killed by prehistoric hunters were found in a single cave in Sicily.

Statistics indicate that the average life of football players is greater than that of baseball players.

The old Greek philosophers condemned suicide, but made an exception of the custom of old people drinking poison hemlock.

Consumption of candy in this country has increased until it now amounts to five pounds per person each year.

Volcanoes Put Salt In The Sea

Geophysics

Following are reports of the meeting of the American Geophysical Union at Washington.

The old question of who put the salt in the sea was referred to Vulcan, mythological patron of volcanoes, by Dr. E. G. Zies of the Geophysical Laboratory of the Carnegie Institution of Washington, who attributed some of the chlorine content of the oceans to the outpourings of hydrochloric acid gases from fumarolic areas, such as the Valley of Ten Thousand Smokes in Alaska. The hydrochloric acid gases change to salt in contact with sodium mineral content of the rocks and water, just as the acid contents of the stomach produce salt when they come in contact with soda or baking powder.

These minor volcanoes and other eruptions also belch forth considerable quantities of hydrofluoric acid gas. This is the acid that will etch glass. To it is due fluorine content of the sea. Recently the sea was discovered to be a veritable mine of fluorine and a floating chemical plant was placed aboard a ship to extract this valuable chemical from the seawater. Dr. Zies declared that so much fluorine is sent down to the sea that some unknown chemical mechanism must be at work to precipitate most of it to the submarine rock floor.

Floating Mountains

Mountains float. This theory, advocated several years ago by Dr. William Bowie, of the U. S. Coast and Geodetic Survey, is now upheld by delicate observations of a moving pendulum, on a submarine in mid-ocean. C. H. Swick, Dr. Bowie's colleague, told of the results of the submarine observations, recently completed by a Dutch scientist, Dr. F. A. Meinesz.

What has been done, Dr. Bowie pointed out following Mr. Swick's paper, is really to weigh, as if on a balance, areas of the ocean bottom against similar sized areas on land, and to show that a mountain, for instance, weighs as much as the corresponding submarine region. Since the ocean area is not as voluminous as the mountain, it must be denser, and this follows his theory of isostasy.

Previously, such measurements of gravity, with the pendulum, have only been made on land, which meant that the 140 million square miles of ocean area could not be surveyed in this way. With the Meinesz apparatus used on a submarine, the ocean regions can be charted for gravity, just as now they are charted for depth.

An idea of the accuracy with which modern land surveys can be made was given by H. G. Avers, also of the Coast and Geodetic Survey. In a levelling survey recently in New England, it was found that the error was only four tenths of an inch in a hundred miles. That is, modern surveyors can start a line a certain distance from the earth's center at Boston, and continue it by means of their levelling instruments to Meriden, Conn., where it will still be within four tenths of an inch of the same distance from the center of the earth.

Such measurements are referred to sea level, but, it was pointed out, sea level varies. Sea level in Maine is a foot higher than in Florida, the height of the Pacific Ocean along California is about eight inches higher than the Atlantic at North Carolina, for example. Recently, it was said, there was some controversy between American and Canadian engineers at Rouses Point, New York, as the Canadian surveys gave results a foot higher than the American. At first each group thought the other in error, but it later proved that the Canadians had referred their measures to Canadian sea level, which is a foot higher than that of the United States.

Recent Active Volcanoes

Recent years, including 1926, 1927 and the first part of 1928, have been of moderate volcanic activity, despite the major eruptions of Mauna Loa in April, 1926, Dr. Harry S. Washington, of the Carnegie Institution's Geophysical Laboratory told the Geophysical Union. This eruption, however, lasted only about three weeks. Since then it has been quiet.

"Subsequent to the very violent explosive eruption of Halemaumau in Kilauea (May, 1924) the crater of Halemaumau has been absolutely quiescent, the lava having sunk out of sight some years ago. There are no signs of renewed activity," Dr. Washington reported. "The 20 odd volcanoes of the Aleutian Islands would seem to have had a season of unusual activity during 1927, according to Dr. Jaggar who visited them that year. Mageik, near the volcano of Katmai (Valley of Ten Thousand Smokes) was in eruption in October, 1927, when a large area was covered with ash. Throughout the Pacific volcanoes generally have been quiet, except for an eruption at the Tonga Islands (1927) and a new volcano at the Galapagos (1926).

"Lassen Peak was quiet during most of this period, but there was a big eruption reported in May, 1927. An observatory was established at this volcano in 1926 to study the volcanic phenomena and earthquakes. In Japan there were two volcanoes in eruption on the island of Hokkaiddo during 1926 which did considerable damage. Izalco, in San Salvador, almost continuously active had a specially violent eruption in November, 1926, when 56 people were killed by a flood of lava. Colima, in Mexico, was reported as active in January, 1926, after 12 years of repose.

"Vesuvius was in its usual state of minor activity, but had eruptions in the summer of 1926, when lava is said to have poured down the outer slope. This was much exaggerated in the newspapers. The reported activity of the Solfatara is somewhat doubtful (1926). The eruption of the Fouque Volcano at Santorini, Greece, which began in August, 1925, came to an end in 1926, but it is reported to have resumed activity in May, 1927. The volcanoes of the Dutch East Indies appear to have been in their normal condition of activity, except that an apparently somewhat violent submarine eruption of Krakatoa took place in January, 1928. It is not known whether this is continuing or not. This is the volcano that had a first magnitude explosive eruption in 1883."

Science News-Letter, May 5, 1928

Young wild animals taken from their mothers too soon and placed in zoos often develop rickets.

Some of the streams rising in Yellowstone National Park eventually flow into the Atlantic and the Pacific Oceans.

The Boston Museum of Fine Arts has acquired one of the oldest known paintings from China, bearing a date corresponding to 607 A. D.

The Chemistry of Life

Chemistry

ALBERT P. MATHEWS, in *General Cytology* (Univ. of Chicago Press):

The biochemist, indeed, has been transformed into an electrical engineer, but an electrical engineer in embryo, in process of becoming; for he is not yet able to understand completely the battery which is put in his charge. He cannot yet construct even the simplest of these; he cannot set one battery and the motor attached to it running or even stop one already running in such a manner that he can set it going again, although he may slow it almost to stopping and increase the speed once more; indeed, he can do no more as yet than see that water and proper chemicals are put in the battery and that the bearings of the motor are oiled and that it is kept reasonably clean. He is rather a cleaner and oiler than the engineer. He is still in the apprentice period of his career. But guided by the great Engineer, Chemical, Electrical, and Mechanical in one, who planned the machine, he hopes some day to make repairs necessary to keep it going for a longer period, and ultimately to make similar machines of a simple kind himself.

But even when we have a reasonably clear picture of these physical things, we cannot make a complete explanation of the chemistry of the cell until we know another and equally important factor which is at present wholly neglected by the chemist and physicist, namely, the psychic element which is the most characteristic, indeed, one might say *the* characteristic thing in living organisms. For living organisms are the largest, as they are the only, psychic units yet recognized. Living things show an attribute which we may call mentality or psychism, and this psychism is as yet unrecognized elsewhere than in living things. No one speaks of the psychology of this great rock upon the illuminated surface of which we crawl, our mother-earth; no one, that is, but the poets, those inspired seers of truth, who catch a glimpse through the fog of the great mountain peaks ahead of us. But who can deny to the inorganic earth that which is in the same inorganic elements when in the organized, the organic form? The biochemist of the future then must be more than an electrical engineer, for he must be poet and psychologist as well.

The psychologist of the future will discuss the psychology of hydrogen, of oxygen, indeed that of the electrons, positive and negative, themselves. For who can doubt that those properties of the atoms which show themselves in the psychical phenomena of living things are also present in the same atoms in the inorganic form? For the atoms are the same in living and lifeless, and every moment they are turning from the one to the other. As Du Bois Reymond put it, the atoms of iron in the great driving wheel of the locomotive and in the brain of the poet are the same.

Science News-Letter, May 5, 1928

Science and Literature

General Science

SIR RICHARD GREGORY in an address before the British Science Masters' Association; quoted in *Nature:*

We are not likely ourselves to forget that science and the humanities are the warp and woof of the fabric of modern life any more than we overlook the human factor in industry; but while these relationships are frequently presented to scientific assemblies, we miss the same friendly gestures to science from our literary colleagues. Men of letters tell us that men of science are the only people who have something to say and are unable to say it and we accept the rebuke, even though we know the difficulty of making the intricate processes of Nature intelligible in the vocabulary of the ordinary life. Our retort, however, may very well be that men of letters should be expected in these days to know a little of Nature and science and to be able, therefore, to exercise their literary art in displaying the wonder and value of the rare treasures which the argosies of scientific explorers are continually bringing into our havens from uncharted seas. Science does not want a divorce from literature but closer union with it and a common understanding of the distinctive qualities by which each can contribute to the fullness of life. It would be easier to mention leaders of science who have enriched literature by their writings than to select men of letters who have exercised their imagination and art upon scientific knowledge and achievement; and we ask those who have the gift of radiant expression to remain no longer outside our temples but to enter and be moved to testify to the revelation which will then be given them.

Science News-Letter, May 5, 1928

The Timeless Hills

Geology

LEONORA SPEYER, in *Fiddler's Farewell* (Knopf):

What are a million years?

These spread peaks
Are Eternity's stone fingers
On which she reckons the rhythm
Of centuries.

And they say the jungle crawled, lush and savage
In this ascetic place.
Once I saw a glacier-rock
Lying numbered on a museum-shelf,
And as if carved upon it,
The drooping slender outline of a palm-leaf
Fallen from a too hot sky.

Count on, stone fingers!
Fingers of ice, recount these careless wonders!

The sea was here.
Hidden beneath the ripples of oncoming hills,
Cattle are grazing on its grassy floor;
The sound of bells drifts by
Like sea-weed on the surface of the air.

What are a million years?

Science News-Letter, May 5, 1928

A federal game warden reported the estimate that five million robins flew over his head in thirty minutes in Randolph County, N. C.

After eight years of civil aviation in England, the British service covers 2,500 miles of air routes in Europe and the Near East.

Old historians said that an Egyption pharaoh of about 600 B. C. sent out a fleet of ships manned by Phoenician sailors to sail around Africa.

Measuring the Billionth of an Inch

Physics

A new instrument of science can measure the billionth of an inch. An iron wire gets hotter when it is magnetized, the heat expands the wire by a billionth of an inch, and science can measure the expansion.

How big is the billionth part of an inch? What fraction of an inch can you measure?

Take up your foot rule and look at it carefully. It is probably marked off in sixteenths of an inch. You could easily estimate a half or a quarter of those spaces. That would enable you to measure 1-32 or 1-64.

If you are going to work very much with small parts of an inch, you will find it more convenient to divide the inch by ten instead of 16, for the same reason that our money is easier to use than English money. Our money is counted by tens, which takes almost no thought. Inches divided by tens can be subdivided by ten again without mental calculation. If your rule is marked in tenths of an inch, you can easily imagine each space marked off again in ten parts, and so can estimate, with little error, to the nearest hundredth of an inch.

The wave-length of one single light-wave is often used as a standard of measure. There are so few really constant quantities in our changing world that it used to be embarrassing to find suitable standards for our units of measures. The original yard is said to have been the length of the arm of a King of Britain. The foot was the length of his foot, and the inch the length from the last joint to the end of his thumb. The king has been dead for many years, if indeed he was not a myth in the first place. His proportions keep marching on because they are a convenient size for measuring things and we have gotten in the habit of using them. The standard to which all yard-sticks are ultimately referred is the distance between two marks on a metal bar suitably preserved in a safe place and carefully guarded against changes of temperature which would expand or contract the bar and so change the measure.

What should we do if the standard yard were to be lost? Its length is a perfectly arbitrary quantity.

When the metric system of measurement was devised, this difficulty was thought to be overcome. The standard meter was defined as a certain exact fraction of the circumference of the earth. But since that day we have found that the earth's crust is changing too much to be a reliable standard. The metric system is too valuable to be depreciated by this discovery, but it, too, now rests on the length of a standard meter, the distance between two scratches on a platinum bar.

T. T. CIOFFI of the Bell Telephone Laboratories, with his photoelectric apparatus for measuring to the billionth of an inch

One of the most important applications of a wave-length of light as a measuring rod is that we are able to define our standards of larger measures in terms of so many times the wave-length of the light of a definite line in the spectrum of the metal cadmium. That is, so far as we know, a definite, unvarying quantity, which can be reproduced at any time.

Light, as every kindergarten child knows, is made up of many colors. The waves which make up the light of each color are different in length from those which make up the other colors. When a small beam of light shines on a ribbed surface, whose roughnesses are nearly as small as the waves of light themselves, the waves reflected from the surface cross and recross like ripples in a stream, and the result is a beautiful band of rainbow colors, because some of the reflected waves combine to form a wave-length which looks blue to us, others to form green, yellow and red. Physicists make diffraction gratings to exhibit this effect by ruling 20,000 to 30,000 parallel lines per inch on glass or metal.

If, however, instead of breaking up the sun's composite white light, pure light of only one wave-length is used, or if the rough surface is just right to send back all the waves of white light without scattering them too much, and if the returning waves are half a wave-length out of step with those they meet, then instead of diffraction of colors we get "interference," and a band of alternate strips of light and darkness.

The most delicate measurements made with light use those light and dark bands, called interference fringes. Dr. A. A. Michelson conceived a remarkable measuring instrument on them when he designed the interferometer.

It might seem that smaller measurements than those with light-waves could not be made. But beyond light waves lie X-ray waves, just like them but much shorter. They are invisible to the eye, but, fortunately, the photographic plate can record them.

In using X-rays for measuring rods, the finest diffraction grating that could be ruled would have ridges a thousand times too coarse to reflect them, but the atoms of matter are about the right size to serve the purpose. If millions of atoms could be lined up in uniform rows, a diffraction grating for X-rays would result.

Physicists had long suspected that the crystals which almost all mineral substances, from diamonds to rock salt, form naturally, have such a regular arrangement of atoms in their make-up, so they tried them out with X-rays, and found the results just what they had expected. The procedure works both ways. Knowing the wave-length of the rays, it is possible to measure the distance between the atoms and (*Turn to next page*)

Billionth of an Inch—*Continued*

to show the pattern of their arrangement. Knowing the arrangement and size of the atoms, the wave-length of the ray may be found.

X-rays have wave-lengths measured in hundred-millionths of an inch. By their use, the former limit of a millionth of an inch has been divided by one hundred. A further division of an X-ray wave-length by ten, and we would have the billionth of an inch.

Quantities of this size are not unknown to physicists who study the series of radiations which includes radio waves, heat waves, light waves, X-rays and the other shorter waves recently studied by Dr. R. A. Millikan and named cosmic rays.

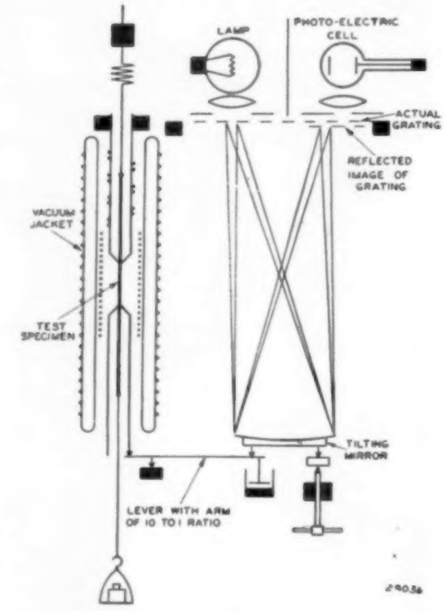
Not wishing to deal with such large fractions as would be necessary if the short waves were measured in parts of an inch or a centimeter, they have other units more in keeping with the size of the quantities they have to measure. The smallest of these, the Angstrom unit, is about a quarter as large as the billionth of an inch.

The new apparatus which measures the expansion of an iron wire to the billionth of an inch is the invention of T. T. Cioffi of the Bell Telephone Research Laboratories. It is used to measure one of the effects of magnetization, because magnetic phenomena play such an important part in telephony.

The Cioffi apparatus is fundamentally a mechanical and not an optical method of measurement. The iron wire which is to be magnetized is hung in a cylinder made like a thermos bottle, so that change of temperature of the air may not cause any part of the expansion to be measured. A coil of wire around it carries the electric current which, when turned on, will magnetize the iron.

When the current flows the iron becomes magnetized. Accompanying the magnetization is the phenomenon of hysteresis which appears as heat. This is the real quantity to be measured. The heat makes the iron wire expand to the extent of about a billionth of an inch. The heat caused by the hysteresis can be measured by the amount of expansion of the iron wire, provided that expansion can be measured accurately enough. The end of the wire is attached to a very delicate lever which will magnify the movement by ten.

Theoretically it would be possible to construct a train of levers, each magnifying the motion of the one before it, as large as one would wish.



HOW TO MEASURE TO A BILLIONTH OF AN INCH. Diagram of the apparatus invented by T. T. Cioffi, of the Bell Laboratories, for making extremely delicate measurements

Practically, however, the friction of the moving parts and the mechanical errors make such a method quite impossible. It is better to use a beam of light for a lever, as it has no friction, and requires no bolts and screws to hold it in place.

So the hundredth-inch push of the lever attached to the magnetized iron wire is used to tilt very slightly one side of a concave mirror, which forms part of such an optical lever. A beam of light from an electric lamp shines upon one side of this mirror, but on its way passes through a piece of glass on which are drawn a number of black lines. Each line and the clear space between each two lines is 1/32 of an inch wide. Bands of alternate light and shadow thus fall upon the mirror and are reflected by it.

The concave mirror does not reflect light back in straight lines to its source, but toward a point out somewhere in space in front of its center. A sheet of paper may be held at that point, called the focus, and an inverted image of the source of the reflection be seen on it. If the eye is placed still farther on, and looks at the focus, the image can be plainly seen hanging in air and entirely transparent, as ghosts are supposed to look.

In the Cioffi apparatus the image of the light and dark lines reflected by the mirror is made to fall on another part of the real sheet of ruled glass. If the apparatus is so adjusted that the dark shadows of the image fall exactly on the dark lines of the glass, the maximum amount of reflected light shines through the glass. If, on the other hand, the image so falls that its bright parts fall on the dark lines, its dark spaces will cover the clear spaces on the glass screen, and none of the reflected light will pass through.

Behind the grating, and cut off from the nearby electric light, is a photo-electric cell, the heart of the whole measuring device. It looks something like an electric light bulb, perhaps like a radio tube, as it is partly silvered inside. Within it is a film of the element potassium, which has very unusual electric powers. Instead of supplying that bulb with electricity and getting light, you reverse the process. Let light shine on it and you will get electricity. The amount obtained is very small, but it can be made to measure itself. It can thus, in the Cioffi apparatus, measure a billionth-of-an-inch expansion of the magnetized wire.

Before the wire to be measured is magnetized, the apparatus is so adjusted that the images of the black lines reflected by the mirror fall on the real black lines of the screen. The cell is then giving out current as strongly as though the lamp were shining directly upon it through the ruled glass.

Throw the switch, magnetize the iron. As the iron expands it pushes the 1 to 10 lever and the lever tilts the mirror about a hundredth of an inch. The image of the grating reflected by the mirror is slightly displaced on the screen. Part of the clear spaces through which light was shining before are now covered by the dark bands of the image. Less light is now shining through the screen to the photo-electric cell. The cell, accordingly, gives off less current. The lessening of the current shows on the indicator, and after a simple calculation, the exact change in length of the magnetized wire is known.

Science News-Letter, May 5, 1928

The best wearing fur is otter.

A considerable proportion of the people of Siberia are farther from the seat of their government at Moscow than they are from the center of the earth.

Cosmic Rays May Cause Evolution

Biology

Following are additional reports of the Washington meeting of the National Academy of Sciences.

Cosmic rays may be the causes of evolution as well as the messengers of the creation of matter in the depths of space. So Prof. H. J. Muller, of the University of Texas, suggested when he announced to the National Academy of Sciences the most recent steps in his revolutionary experiments with X-rays as man-controlled tools for the making of new species out of old.

The mutations, or evolutional jumps, which Prof. Muller produces by thousands with his X-rays, also occur in nature in smaller numbers, apparently spontaneously. It has been suggested, Prof. Muller said, that even these spontaneous mutations may be due to natural radiations resembling X-rays, which are found almost everywhere, though their force is usually rather feeble. Traces of radium in soil or water, and the larger amounts of weaker but more abundant radioactive elements which are present on earth, give off X-rays and other radiations of the same class. And the cosmic rays from the heavens, which Dr. R. A. Millikan announced earlier in the sessions as signals of matter's creation, are also possible shifters and rearrangers of the minute building-block genes in the germinal cells.

To test this cosmic ray theory of evolution, Prof. Muller hopes to conduct fly-breeding experiments protected from the powerful rays of heaven that can penetrate 200 feet of water or 18 feet of lead. Special food and water, free from radioactive matter, would be given to the flies. If a non-evolving race of insects should result, Dr. Muller's theory would be substantiated.

Mosaic fruit-flies have been evolved by Dr. Muller's associate, Prof. J. T. Patterson. He X-rayed the larvae, or young of the fruit-flies instead of the adult insects, and obtained patchwork evolution. The larval cells that were hit and changed by the X-rays divided and grew into patches of body-material quite different from the original type. The rest of the insect remained "as was," so that the resulting creature was a mosaic of bits of new-species tissue fitted into an old-species body.

New Science of Music

A science of music is at last being developed, said Dr. Carl E. Seashore, of the University of Iowa. The man who has the largest responsibility for developing the anthropology of music as an applied science is the psychologist. The reason why scientific knowledge of the subject has been delayed is that psychology is still an infant science. But with equipment and knowledge now available, songs can be recorded just as they are sung, music can be described in psychological terms, and musical talent can be measured.

The phonograph as a means of collecting primitive music has had its day and is now superseded by the camera, Dr. Seashore pointed out. A musical score has been devised for recording the rendition of songs which shows at a glance the form of the pitch and duration of each note, and how the note is attacked and held and released.

About twenty factors in musical talent can now be objectively measured to show the extent of an individual's musical possibilities and his strong and weak points, Dr. Seashore reported.

Algae in the Canyon

Numerous fossil remains of plants, belonging to the lowly water forms known as algae, have recently been discovered in the ancient rocks near the bottom of the Grand Canyon of Arizona. Dr. David White, of the U. S. Geological Survey, told of his investigations among the Proterozoic rocks and the peculiar stony masses he found there, representing what were once great matted heaps of seaweed or similar plants on the bottom of a sea that existed nearly a billion years ago. At least five different types of deposits in these strata represent the plant life of those primal oceans, in Dr. White's opinion, and there is at least one additional type of stone which was influenced in its formation by either plant or animal life, with the probabilities in favor of a plant origin.

Evolution Controversy

A difference of opinion over the evolution of man himself developed during the session of the academy. Dr. J. W. Gidley, of the U. S. National Museum, reported his recent discovery of an arrow point buried in the soil of Florida, associated with bones of animals that roamed America during the Ice Age, which is usually assumed to have ended 30,000 years ago. Dr. Ales Hrdlicka, also of the U. S. National Museum, doubting whether man existed on this continent so long ago, pointed out the relative scarcity of human remains and instruments found in America, as contrasted with their abundance in the caves of Europe, and the absence among the American stone implements of the graded series from early crude specimens to the later highly finished types.

Medals Awarded

Four gold medals of the National Academy were awarded this year. Dr. William Hammond Wright of Lick Observatory who announced new studies of Mars was given the Henry Draper medal for research in astrophysics. The Public Welfare Medal was presented Dr. Charles V. Chapin, health officer of Providence, R. I., and the Mary Clark Thompson Medal was given Prof. J. Perrin Smith of Stanford University for his paleontological work upon the ancient rocks of the Jurassic. Announcement was made of the award of the Agassiz Medal for oceanography to Prof. V. Walfrid Ekman, University of Lund, Sweden.

New Medal Established

A new medal that will be awarded in future years was announced at this meeting of the Academy. It is the Charles Doolittle Walcott Award, and is established in honor of the late secretary of the Smithsonian Institution by his widow, Mrs. Mary Vaux Walcott. According to the terms of the award, it is to be given "to encourage and reward individual achievement in advancing our knowledge of pre-Cambrian life and its history in any part of the world." It consists of a medal and the income accumulated for a period of five years, from the fund of $5,000, and awarded by a joint committee of the Academy and other organizations.

Nine New Members

Two psychologists, two chemists, an anthropologist, an astronomer, an electrical engineer, a paleontologist and a geologist are the new members elected to the academy.

John August Anderson, astronomer at the Mt. (*Turn to next page*)

National Academy of Sciences Meeting—*Continued*

Wilson Observatory in California, represents the students of the stars, but his invention of a new type of earthquake recorder, in collaboration with his colleague, Dr. Harry O. Wood, has provided a simple means of detecting quakes.

An important chemical tool, hydrogen ion concentration determination, was developed in this country in part by Dr. William Mansfield Clark, of the Johns Hopkins University Medical School. He worked on the chemistry of cheese while in the bureau of dairy chemistry of the U. S. Department of Agriculture and later he was with the U. S. Hygienic Laboratory.

When it comes to the geology of the Appalachian Mountains, Dr. Arthur Keith, the geologist elected, can speak with authority, for that is one of his specialties. He is now with the U. S. Geological Survey.

It is to Charles Franklin Kettering, the electrical engineer of the group, that millions of farmer owe their thanks for having electrical illumination in their homes, for he perfected and put on the market the "Delco" lighting system. He developed the tetra ethyl anti-knock fuel for autos and perfected the "Delco" ignition system for automobiles. Now he is a vice-president and director of the General Motors Corporation, and at the head of the General Motors research laboratory.

Dr. Alfred L. Kroeber, the anthropologist, is one of the leading authorities on the languages of the American Indian. He is professor of anthropology at the University of California.

Paleontology, the study of now extinct forms of animal life, finds its representative in Dr. Rudolph Ruedemann, state paleontologist for New York. He is a German by birth, and taught at the University of Strassburg before coming to the United States in 1892.

Problems of metabolism, or the functioning of the body, have engaged the attention of Dr. Philip Anderson Shaffer, professor of biochemistry at the Washington University Medical School, St. Louis.

The two psychologists are Dr. George Malcolm Stratton, of the University of California, at Berkeley, and Dr. Lewis Madison Terman, of Stanford University, California. Between them they represent two great branches of psychology. Dr. Terman is the author of the Stanford Revision of the Binet-Simon tests, with which millions of persons have had their intelligence tested. Many other series of intelligence tests have been based largely on his work. Dr. Stratton is an experimental psychologist. One of his researches was concerned with vision, and in the course of his experiments he wore for days a pair of spectacles that made everything appear upside down.

As a foreign associate, the academy elected Sir Robert A. Hadfield, famed British engineer, chemist and metallurgist. He is the inventor of manganese steel, widely used in industry.

Dr. Joseph S. Ames, provost of the Johns Hopkins University was elected treasurer of the academy, while Dr. W. B. Cannon, of the Harvard University Medical School, and Gano Dunn, New York engineer, were elected to serve three years on the Council. Dr. George K. Burgess, director of the U. S. Bureau of Standards, was elected chairman of the National Research Council, succeeding Gano Dunn.

Science News-Letter, May 5, 1928

Man and the Universe

Astronomy

J. H. JEANS, in a lecture before the Royal Society, published in *Nature*:

The total age of the earth far exceeds the 300,000 years or so of man's existence. The evidence of geology, and of radio-activity in rocks in particular, shows that it must be something like 2,000 million years, which is several thousand times the age of the human race. Old Mother Earth must regard man as a very recent apparition indeed; he has just appeared to burrow into her, burn her forests, put her waterfalls into pipes, and generally mar the beauty of her features. If he has done so much in the first few moments of his existence, she may well wonder what is in store for her in the long future ages in which he is destined to labour on her surface. For in all probability the life in front of the human race must enormously exceed the short life behind it. A million million years hence, so far as we can foresee, the sun will probably still be much as now, and the earth will be revolving round it much as now. The year will be a little longer, and the climate quite a lot colder, while the rich accumulated stores of coal, oil, and forest will have long been burnt up; but there is no reason why our descendants should not still people the earth. Perhaps it may be unable to support so large a population as now, and perhaps fewer will desire to live on it. On the other hand, mankind, being three million times as old as now, may—if the conjecture does not distress our pessimists too much—be three million times as wise.

Looked at on the astronomical time-scale, humanity is at the very beginning of its existence—a new-born babe, with all the unexplored potentialities of babyhood; and until the last few moments its interest has been centered, absolutely and exclusively, on its cradle and feeding-bottle. It has just become conscious of the vast world existing outside itself and its cradle; it is learning to focus its eyes on distant objects, and its awakening brain is beginning to wonder, in a vague, dreamy way, what they are and what purpose they serve. Its interest in this external world is not much developed yet, so that the main part of its faculties is still engrossed with the cradle and feeding-bottle, but a little corner of its brain is beginning to wonder.

Taking a very gloomy view of the future of the human race, let us suppose that it can only expect to survive for two thousand million years longer, a period about equal to the past age of the earth. Then, regarded as a being destined to live for three-score years and ten, humanity, although it has been born in a house seventy years old, is itself only three days old. But only in the last few minutes has it become conscious that the whole world does not centre round its cradle and its trappings, and only in the last few ticks of the clock has any adequate conception of the size of the external world dawned upon it. For our clock does not tick seconds, but years; its minutes are the lives of men.

Science News-Letter, May 5, 1928

CLASSICS OF SCIENCE: Stonehenge as an Observatory

Astronomy-Archæology

You can construct a primitive observatory by setting up sight-lines to mark the place where you observe the sun to rise on June 21, December 21, and the points half-way between, where the sun rises at the times of the equinox.

STONEHENGE and Other British Stone Monuments Astronomically Considered, by Sir Norman Lockyer, K. C. B., F. R. S. London, 1906.

The Agricultural Year

The early peoples have been very much misrepresented, and held to have been uninstructed, by several writers who have not considered what they were really driving at. It was absolutely essential for early man, including the inhabitants of Britain as it was then—townless, uncivilized—that the people should know something about the proper time for performing their agricultural operations. We now go into a shop and for a penny buy an almanack which gives us everything we want to know about the year, the month and the day, and that is the reason why so few of us care about astronomy; we can get all we want from astronomy for a penny or twopence. But these poor people, unless they found out the time of the year and the month and the day for themselves, or got some one to tell them—and their priests were the men who knew, and they were priests because they knew—had absolutely no means of determining when their various agricultural operations should take place. So that we find all over the world temples erected in the very first flash of civilisation.

On this a point comes in of very considerable interest. If we study the civilisations in Egypt, we find that, so far as we know, one of the first peoples who used this principle of orientation for agricultural purposes was some tribe that came down the Nile about 6400 years B. C. They used the star Canopus, and their determination was that of the autumnal equinox, which practically was the time when the Nile began to go down, and when their sowing might begin. There was another race who, instead of being interested in the sun, and therefore in agriculture, at the time of autumnal equinox, were interested in the year about the time of Easter as well. This race built the Pyramids about four thousand years B. C. There was an interval of about two or three thousand years between these races. As we shall see there were others, who at Thebes started the solstitial worship—that is to say,

TRILITHONS AT STONEHENGE. Although used for observing the summer solstice, Lockyer found indications that the inner ring of stones was set up for marking the farmers' year beginning with May

the worship of the sun at midsummer—and at Memphis in May, so as to enable them to go on with their agricultural operations with greater certainty.

When we study the history of our own country—when we come back from Egypt to Britain, leaving alone Greece and Rome—we find that in various times in our country we have had a year, a farmer's year, beginning in the month of May; we have had another farmer's year beginning in the month of August; we have had another farmer's year beginning at the longest day; and it appears that the year beginning at the longest day was really the last year to be introduced. So that while we have in Stonehenge a solstitial temple—that is to say, a temple to make observations of the length of the year by observing the rise of the sun on the longest day of the year—in other parts of England there were other temples observing the sun, not on the 21st of June, but early in May and early in August.

Horizon for Reference

After Mr. Penrose, by his admirable observations in Greece, had shown that the orientation theory accounted as satisfactorily for the directions in which the chief temples in Greece had been built as I had shown it did for some in Egypt, it seemed important to apply the same methods of inquiry with all available accuracy to some example, at all events, of the various stone circles in Britain which have so far escaped destruction. Many attempts had been previously made to secure data, but the instruments and methods employed did not seem to be sufficient.

Much time has, indeed, been lost in the investigation of a great many of these circles, for the reason that in many cases the relations of the monuments to the chief points of the horizon have not been considered; and when they were, the observations were made only with reference to the magnetic north, which is different at different places, and besides is always varying; few indeed have tried to get at the astronomical conditions of the problem. . . .

In order to obtain some measurements to test the orientation theory in Britain, I found that Stonehenge is the ancient monument in this country which lends itself to accurate theodolite work better than any other.

Acting on a very old tradition, some people from Salisbury and other surrounding places go to observe the sunrise on the longest day of the year at Stonehenge. We therefore are *(Turn to next page)*

Stonehenge as an Observatory—*Continued*

perfectly justified in assuming that it was a solar temple used for observation in the height of midsummer. But at dawn in midsummer in these latitudes the sky is so bright that it is not easy to see stars even if we get up in the morning to look for them; stars, therefore, were not in question, so that some other principle had to be adopted, and that was to point the temple directly to the position on the horizon at which the sun rose on that particular day of the year, and no other.

Now, if there were no change in the position of the sun, that, of course, would go on for ever and ever; but, fortunately for archæologists, there is a slight change in the position of the sun, as there is in the case of a star, but for a different reason; the planes of the ecliptic and of the equator undergo a slight change in the angle included between them. So far as we know, that angle has been gradually getting less for many thousands of years, so that, in the case of Stonehenge, if we wish to determine the date, having no stars to help us, the only thing that we can hope to get any information from is the very slow change of this angle; that, therefore, was the special point which Mr. Penrose and I were anxious to study at Stonehenge, for the reason that we seemed in a position to do it there more conveniently than anywhere else in Britain.

But while the astronomical conditions are better at Stonehenge than elsewhere, the ruined state of the monument makes accurate measurements very difficult.

Economical Temples

Although I have before hinted that the astronomical use of the Egyptian temples and British circles was the same, there is at first sight a vast difference in the general plan of structure.

This has chiefly depended upon the fact that the riches and population of ancient Egypt were so great that the people could afford to build a temple to a particular star, or to the sun's position on any particular day of the year. The temple axis along the line pointing to the celestial body involved, then became the chief feature, and tens of years were spent in lengthening, constricting and embellishing it.

In Britain the case was different, there was neither skill nor workers sufficient to erect such stately piles, and as a consequence one structure had to do the work of several and it had to be done in the most economical way. Hence the circle with the observer at the centre and practically a temple axis in every direction among which could be chosen the chief directions required, each alignment being defined by stones, more or less distant, or openings in the circle itself.

Now for some particulars with regard to those parts of Stonehenge which lend themselves to the inquiry.

The main architecture of Stonehenge consisted of an external circle of about 100 feet in diameter, composed of thirty large upright stones, named sarsens, connected by continuous lintels. The upright stones formerly stood 14 feet above the surface of the ground. They have nobs or tenons on the top which fit into mortice holes in the lintels. Within this peristyle there was originally an inner structure of ten still larger upright stones, arranged in the shape of a horseshoe, formed by five isolated trilithons which rose progressively from N. E. to S. W., the loftiest stones being 25 feet above the ground. About one-half of these uprights have fallen, and a still greater number of the imposts which they originally carried.

There is also another circle of smaller upright stones, respecting which the only point requiring notice now is that none of them would have interrupted the line of the axis of the avenue. The circular temple was also surrounded by the earthen bank . . .of about 300 feet in diameter, interrupted towards the northeast by receiving into itself the banks forming the avenue before mentioned, which is about 50 feet across. Within this avenue, no doubt an old *via sacra,* and looking northeast from the center of the temple, at about 250 feet distance and considerably to the right hand of the axis, stands an isolated stone, which from a medieval legend has been named the Friar's Heel.

The axis passes very nearly centrally through an intercolumniation (so to call it) between two uprights of the westernmost trilithon as it originally stood. . . .

These earthen banks defining the avenue do not exist alone. . . . There is a general common line of direction for the avenue and the principal axis of the structure; and the general design of the building, together with the position and shape of the naos, indicates a close connection of the whole temple structure with the direction of the avenue. There may have been other pylon and screen equivalents as in other ancient temples, which have disappeared, the object being to confine the illumination to a small part of the naos. There can be little doubt, also, that the temple was originally roofed in, and that the sun's first ray, suddenly shining into the darkness, formed a fundamental part of the cultus. . . .

Date of Construction

There is a difference in treatment between the observations required for Stonehenge and those which are available for Greek or Egyptian solar temples. In the case of the latter, the effect of the precession of the equinoxes upon the stars, which as warning clock stars were almost invariably connected with those temples, offers the best measure of the dates of foundation; but in Britain, owing to the brightness of the dawn at the summer solstice, such a star could not have been employed, so that we rely only on the secular change of the obliquity as affecting the azimuth of the point of sunrise. . . .

It is to be understood that on account of the slight uncertainty as to the original line of observation and the very slow rate of change in the obliquity of the ecliptic, the date thus derived may possibly be in error by 200 years more or less; this gives us a date of construction lying between say 1900 and 1500 B. C.

Sir Joseph Norman Lockyer was born at Rugby, England, May 17, 1836, and died at Sidmouth in Devonshire, August 16, 1920. He was educated on the continent, and at 21 became a clerk in the War Office. He studied astronomy in his spare time, and at the age of 30 began to study sunspots with the spectroscope. This soon led him to the discovery of the method of studying solar prominences in full daylight with the same instrument. In the same year Lockyer discovered a bright yellow spectral line of an unknown element in the sun, and named the element "helium." In 1887, Lockyer published the results of his spectroscopic researches as "The Chemistry of the Sun," and in 1897 he published "The Sun's Place in Nature," which classifies the stars on the basis of the light they emit. In 1894, Lockyer turned his astronomical knowledge to the interpretation of archæology in his "Dawn of Astronomy." "Stonehenge," from which the accompanying classic is gleaned, is its sequel, in which the laws of orientation of the elaborate temples of Greece and Egypt are found to apply no less to the rude stone circles of primitive England.

First Glances at New Books

HANDBUCH DER ASTROPHYSIK: BAND VI: DAS STERNSYSTEM—F. C. Henroteau and others—*Julius Springer* (Berlin) (66 RM.). For the last few years astronomers of the United States have been hearing about an exhaustive and monumental work on astrophysics that was under preparation in Germany, and to which several American and Canadian astronomers were contributing. Here is the first volume to appear, though it will be the last of six when the set is completed. The publishers announce that the remaining volumes will appear during 1928 and 1929. Judging from this, the set will be fully up to the greatest expectation. Here are four articles, three of which are in English. Dr. F. C. Henroteau, of the Dominion Observatory, Ottawa, writes on double stars; Dr. F. J. M. Stratton, of Cambridge, on novae; Prof. K. G. Malmquist, of Lund, on radical velocities of the stars, and Prof. H. Ludendorff, of Potsdam (in German) on variable stars. Despite the high price of the book, it is to be heartily recommended to anyone who wants the last word on these phases of astrophysics by leading authorities.

Astronomy
Science News-Letter, May 5, 1928

THE CONSTELLATIONS AND THEIR HISTORY — Charles Whyte — *Lippincott*. The fact that a book published in 1899 has, until now, been the chief work on the history of the constellations shows the need that has existed for a similar volume that would include the latest discoveries. Mr. Whyte's book goes far to fill this vacancy, for he includes such important developments of recent years as the measurement of star diameters by the interferometer, Hubble's measurements of the distance of the spiral nebulæ and Aitken's discovery of the duplicity of omicron Ceti.

Astronomy
Science News-Letter, May 5, 1928

THE MIND BEHIND THE UNIVERSE —Theodore A. Miller — *Stokes* ($1.50). A philosophical discussion designed for those who are not professional philosophers.

Philosophy
Science News-Letter, May 5, 1928

MUSCULAR MOVEMENT IN MAN: THE FACTORS GOVERNING SPEED AND RECOVERY FROM FATIGUE—A. V. Hill —*McGraw-Hill* ($2.50). A quantitative discussion of human kinetics.

Physiology
Science News-Letter, May 5, 1928

THE NEWER KNOWLEDGE OF BACTERIOLOGY AND IMMUNOLOGY—Edited by Edwin O. Jordan and I. S. Falk—*The University of Chicago Press* ($10). This heavy volume (there are 1196 pages) has the praiseworthy object of making available to students and active workers the latest results of investigations in bacteriology and immunology. Eighty-two authorities in their respective specialties have contributed the chapters which make the book an invaluable reference for all whose work touches on this rapidly advancing field.

Bacteriology
Science News-Letter, May 5, 1928

PIVOTAL FIGURES OF SCIENCE—Arthur E. Bostwick — *American Library Association, Chicago* (35 cents). The outline for "Reading with a Purpose" series aims to awaken an interest in science through the study of biographies of the leaders in scientific research. The books recommended are:

MAKERS OF SCIENCE, by Ivor B. Hart; HEROES OF THE SCIENTIFIC WORLD, by Charles R. Gibson; LEADING AMERICAN MEN OF SCIENCE, by David Starr Jordan, ed.; CHARLES DARWIN, by Gamaliel Bradford; THE LIFE OF PASTEUR, by René Vallery-Radot; PIERRE CURIE, by Marie Sklodowska Curie; FROM IMMIGRANT TO INVENTOR, by Michael Pupin.

General Science
Science News-Letter, May 5, 1928

LET FREEDOM RING—Arthur Garfield Hays — *Boni and Liveright* ($2.50). One of the chief moving spirits of the Civil Liberties Union recites a few chapters of the mad things Americans have done to each other when fear has made them blind. The first 90 pages of the book is devoted to an account of the Dayton evolution case.

Sociology
Science News-Letter, May 5, 1928

HYMEN OR THE FUTURE OF MARRIAGE—Norman Haire—*Dutton* ($1). The author admits that his view of the future of marriage will be found "startling" by many readers. It will also be found shocking.

Psychology
Science News-Letter, May 5, 1928

CITRUS PRODUCTS, PART II—James B. McNair—*Field Mus. of Nat. Hist.* The second part of an exhaustive monograph covering both the biological and economic aspects of citrus fruit industries throughout the world.

Agriculture
Science News-Letter, May 5, 1928

NATURE RAMBLINGS
BY FRANK THONE

Natural History

Fleur-de-Lis

When you come upon the reedy margin of a pond, or a wet meadow, you are very likely to find this flower, delicate blue and yellow, sufficient all by itself to make a day in spring, though all other buds were sealed. It is the wild Iris, which is the Fleur-de-Lis, the most gallant, the bravest, the most famous of flowers, and yet withal the most lovely. Riding above the stiff sword-blades of its leaves, it is like Jeanne d'Arc above the spears of her army, something at once bold and delicate, strong and yet sweet.

It is wholly appropriate that this flower should have blossomed for so long on the banners of France, that it should have been the symbol also of the city of Dante, of Florence, "the city of flowers." It is the kind of flower that lifts itself to a place in a flag. Do not even old farmer's wives, who know nothing of glory and whose romance went out long ago, still call them "flag-flowers"?

But the pride of the wild iris is of even more ancient lineage than this. There is an iris that blooms in the stony fields of Palestine, a much brighter one than ours, a veritable Oriental dream of gorgeousness. The ancients were not exact in their botany; iris and lily were one to them, and so it is that when Jesus of Nazareth sought a symbol of careless glory surpassing even that of a careful king, his eye and word lighted upon an iris that was a fleur-de-lis, or, being Englished, a "lily flower."

The economic loss from automobile accidents figured in terms of persons killed and injured totals almost three billion dollars in the past five years.

A slab in the Berlin Museum dating about 2600 B. C., from a temple in Egypt, shows the various processes in smoking honey, putting it in jars, pressing and sealing it.

A Statement of Purpose

(The aims, ideals and aspirations of an institution)

SCIENCE SERVICE is a unique institution, established at Washington for the purpose of disseminating scientific information to the public. It aims to act as a sort of liaison agency between scientific circles and the world at large. It interprets original research and reports the meetings of learned societies in a way to enlighten the layman. The specialist is likewise a layman in every science except his own and he, too, needs to have new things explained to him in non-technical language. Scientific progress is so rapid and revolutionary nowadays that no one can keep up with it from what he learned at school. Science Service endeavors to provide life-continuation courses in all the sciences for newspaper readers anywhere in America without tuition fees or entrance examinations.

In a democracy like ours it is particularly important that the people as a whole should so far as possible understand the aims and achievements of modern science, not only because of the value of such knowledge to themselves but because research directly or indirectly depends upon popular appreciation of its methods. In fact the success of democratic institutions, as well as the prosperity of the individual, may be said to depend upon the ability of people to distinguish between science and fakes, bewteen the genuine expert and the pretender.

Science Service spares no pains or expense in the endeavor (1) to get the best possible quality of popular science writing and (2) to get it to the largest possible number of readers. If in doing this it can make both ends meet, so much the better. If not, it will do it anyway.

Through the generosity of E. W. Scripps, Science Service has been assured of such financial support as to insure its independence and permanence. Mr. Scripps's long and wide experience as a newspaper editor and proprietor had convinced him of the importance of scientific research as the foundation of the prosperity of the nation and as guide to sound thinking and living and he realized the need for an independent agency that would bring the results of research to the attention of the entire people so these could be applied to the solution of their personal, social or political problems.

Science Service is chartered as a non-profit-making institution and all receipts from articles, books, lectures and films are devoted to opening up new avenues for the diffusion of knowledge and developing promising methods of popular education. Although Science Service has a philanthropic purpose, it is conducted on business principles, with the aim of making each branch of its activities ultimately self-supporting so far as possible. All acceptable contributions are paid for and all published articles are charged for.

Science Service is under the control of a Board of Trustees composed of ten scientists and five journalists. The leading national organizations of all the sciences, the National Academy of Sciences, the National Research Council, and the American Association for the Advancement of Science, appoint three trustees each.

Science Service occupies offices in the magnificent new building of the National Academy of Sciences and the National Research Council on Potomac Park opposite the Lincoln Memorial.

This strategic situation enables the Service to keep constantly in touch with the progress of the sciences because new inventions and discoveries are promptly put on exhibition in the building, and the Council brings together investigators in the various sciences and leaders in engineering and industry from all parts of the country.

Science Service is not a governmental institution, but it is in close contact with the numerous governmental bureaus of research. It is not under the control of any clique, class or commercial interest. It is not the organ of any single scientific association. It serves all the sciences. It engages in no propaganda, unless it be called propaganda to urge the value of research and the usefulness of science.

Science Service began its work on January 1, 1921, and has now a sizable office staff with a large corps of contributors in the chief research institutions of this country and Europe.